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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
09/905,053	07/12/2001	Hung-Tien Yu	005552	3453

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EXAMINER	
LEE, HSIEN MING	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 03/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/905,053	Applicant(s) YU ET AL.	
	Examiner Hsien-Ming Lee	Art Unit 2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 December 2002*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *9*
4) ☐ Interview Summary (PTO-413) Paper No(s) _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-4, 6-8, 13, 14 and 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Shufflebotham et al. (US 6,106,678).

In re claim 1, 2 and 7, Shufflebotham et al. expressly teach the claimed deposition method capable of filling recesses in a substrate, comprising:

- providing a substrate 40 having a recess 38 defining side walls and recess bottoms (Fig.5);
- exposing the substrate 40 to an energized deposition gas (i.e. a deposition gas has been energized by a plasma assisted CVD deposition method) comprising first O_2 and second SiH_4 components to deposit a first layer of a material SiO_2 in the recess 38 (Fig.5; col. 7, lines 46-53; col. 8, lines 16-17) at <u>different rates</u> over the side walls and recess bottoms (col. 6, lines 37-58; col.6, line 66 through col.7, line 17; col.8, lines 16-25); and
- reducing the ratio of the first component O_2 to the second component SiH_4 (i.e. <u>reducing a flow rate of the first component O_2</u>; col. 7, lines 16-17; col.8, lines 16-19)

to deposit a second layer of the material SiO_2 over the first layer of SiO_2 in the recess 38 (Fig.5; col. 8, lines17-21).

In re claim 3, Shufflebotham et al. expressly teach that the first component comprises O_3 (col. 9, lines 15-18)

In re claim 4, Shufflebotham et al. inherently teach that the reducing step is performed by reducing the flow rate of O_3 in light of the teachings regarding reducing the flow rate of the first component O_2 as taught in col. 7, lines 16-17 and col.8, lines 16-19.

In re claim 6, Shufflebotham et al. expressly teach that the second component comprises TEOS. (col.9, lines 16-18)

In re claim 8, Shufflebotham et al. expressly teach that the flow rate of the first component O_2 is gradually reduced (i.e. the O_2 flow rate is gradually reduced by 50% for every 2 second for 6 times). (col.8, lines 16-19)

In re claims 13 and 14, Shufflebotham et al., in light of the teachings utilizing O_2 and SiH_4 as the first and second components as stated above, also inherently teach the claimed deposition method capable of filling recesses in a substrate, comprising:

- providing a substrate 40 having recesses 38 defining side walls and recess bottoms (Fig.5);
- exposing the substrate 40 to an energized deposition gas (i.e. a deposition gas has been energized by a plasma assisted CVD deposition method) comprising a first volumetric flow rate of O_3 and TEOS (col. 9, lines 16-18) to deposit a first layer of SiO_2 in the recesses 38 (Fig.5; col. 7, lines 46-53; col. 8, lines 16-17) at different rates over the side walls and recess bottoms; and

- reducing the volumetric flow rate of the O_3 to TEOS (i.e. reducing a flow rate of the O_3) to deposit a second layer of the SiO_2 over the first layer of SiO_2 in the recesses 38. (Fig.5).

In re claim 18, Shufflebotham et al. also inherently teach depositing the first layer of SiO_2 to a sufficient thickness to fill the reentrant cavities, i.e. depositing the first layer of SiO_2 having a sufficient thickness to fill the recess bottom but not to block the recesses to prevent the formation of voids. (col.8, lines 16-26)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 5, 9-12, 15-17 and 19-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shufflebotham et al. (US '678) in view of applicant's admitted prior art (hereinafter referred as "AAPA").

In re claims 5, 9, 15 and 22, the selection of the time for the ratio-reducing step is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). For example, the time for the ratio-reducing step depends on the aspect ratio of the recess, i.e. the higher aspect ratio the longer the time it becomes. In such situation, the

applicant must show that the claimed time is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range. See M.P.E.P. 2144.05 III.

In re claims 12, 19 and 23, the selection of the thickness of the first silicon oxide layer is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). For example, the thickness of the first silicon oxide may be optimized to a desired range so that the first silicon oxide is thick enough to substantially fill the bottom of the recess while still keeps the recess open. The open-recess is then filled with the second silicon oxide layer, which in turn would avoid the formation of voids in the recess. In such situation, the applicant must show that the claimed thickness range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range. See M.P.E.P. 2144.05 III.

In re claims 10, 11, 16 and 20, Shufflebotham et al. fail to teach the recess being between polysilicon gates and having sidewall portions covered with silicon nitride spacers, and wherein the silicon nitride spacers, the polysilicon gates and the other portions of the substrate are covered with a silicon nitride liner. \

However, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to appreciate that the teachings of Shufflebotham et al. is an illustrative example rather than restrictive: and variations can be made without departing from the spirit and scope of the teachings of Shufflebotham et al (col.11, lines 48-55, Shufflebotham et al). For

example, one of the ordinary skill in the art would have been motivated to apply the teachings of Shufflebotham et al to any situations that needs to fill the recess having a high aspect ratio as shown in AAPA.

In Fig. 1, AAPA teaches a structure having the recesses 27 being between polysilicon gates 22 and having sidewall portions covered with silicon nitride spacers 24, and wherein the silicon nitride spacers 24, the polysilicon gates 22 and the other portions of the substrate are covered with a silicon nitride liner 26; and the recesses 27 are filled with the silicon oxide 28.

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to apply the teachings of Shufflebotham et al. to the AAPA's structure with a reasonable expectation of success because it would achieve same results (i.e. capable of filling high-aspect-ratio recesses without having voids) by applying the teachings of Shufflebotham et al. in the process of AAPA.

In re claim 17, Shufflebotham et al. in view of AAPA teach that the silicon nitride liner 26 comprises reentrant cavities as shown in Fig.1 of AAPA; and the reentrant cavities are smoothened by the first silicon oxide layer of Shufflebotham et al, wherein the first silicon oxide is formed by TEOS and O_3; and the first silicon oxide has a sufficient thickness to fill the reentrant cavities.

In re claim 21, Shufflebotham et al. in view of AAPA teach that the ratio-reducing step is performed by reducing the flow rate of O_3 as stated above.

Response to Arguments

5. Applicant's arguments filed 12/20/02 have been fully considered but they are not persuasive as reasons as follow.

Applicants argue that Shufflebotham et al. rely on the sputtering action of ions in HDP-CVD approach to fill gap without void formation, not via different deposition rate as asserted. (second paragraph, page 11).

Contrary to the argument, Shufflebotham et al. expressly teach that by manipulating the first and second components (i.e. O2/SiH4 or O3/TEOS) it would effect the deposition rate (col.7, lines 15-17). Shufflebotham et al. further indicate that with the aforementioned manipulation in conjunction with other parameters (e.g. RF bias; col. 8, lines 10-33) the SiO2 layers are filled in the high-aspect-ratio recess at different deposition rate via reducing the O2 flow rate by 50% for every 2 seconds for 6 times. (col.8, lines 16-19). With the approach of Shufflebotham et al., a void-free recess-filling can be obtained. (col.8, lines 20-26).

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-305-0142 for regular communications and 703-305-0142 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Hsien Ming Lee
February 26, 2003